CONTROLLING USER INTERFACE FORCE

FIELD

[0001] This invention generally relates to electronic devices.

BACKGROUND

[0002] Input devices, including proximity sensor devices (also commonly called touchpads or touch sensor devices), are widely used in a variety of electronic systems. A proximity sensor device typically includes a sensing region, often demarked by a surface, in which the proximity sensor device determines the presence, location and/or motion of one or more input objects. Proximity sensor devices may be used to provide interfaces for the electronic system. For example, proximity sensor devices are often used as input devices for larger computing systems (such as opaque touchpads integrated in, or peripheral to, notebook or desktop computers). Proximity sensor devices are also often used in smaller computing systems (such as touch screens integrated in cellular phones).

SUMMARY

[0003] In general, in one aspect, one or more embodiments relate to a method for controlling a user interface using an indirect input device. The method includes determining a first touchdown location of an input object, determining a first subsequent location of the input object, calculating a first direction and a first distance between the first touchdown location and the first subsequent location, and moving a cursor representation on a display in a second direction and at a velocity. The second direction is defined by the first direction, the velocity based on the first distance and a first force imparted by the input object on an input surface. The method further includes detecting a touchdown event of at least two input objects, determining a second touchdown location of the at least two input objects, determining a second subsequent location of the at least two input objects, calculating a third direction and a second distance from the second touchdown location and the second subsequent location, and modulating a user interface action in a fourth direction at a magnitude. The fourth direction is based on the third direction, and the magnitude is based on the second distance and a second force imparted onto the input surface.

[0004] In general, in one aspect, one or more embodiments relate to a processing system for controlling a user interface using an indirect input device. The processing system includes a sensor module including sensor circuitry coupled to sensor electrodes, the sensor module configured to transmit transmitter signals and receive resulting signals with at least a portion of the sensor electrodes. The processing system further includes a determination module operatively connected to the sensor electrodes and configured to determine a first touchdown location of an input object, determine a first subsequent location of the input object, calculate a first direction and a first distance between the first touchdown location and the first subsequent location, and move a cursor representation on a display in a second direction and at a velocity. The second direction is defined by the first direction, and the velocity is based on the first distance and a first force imparted by the input object on the input surface. The determination module is further configured to detect a touchdown event of at least two input objects, determine a second touchdown location of the at least two input objects, determine a second subsequent location of the at least two input objects, calculate a third direction and a second distance from the second touchdown location and the second subsequent location, and modulate a user interface action in a fourth direction at a magnitude. The fourth direction is based on the third direction. The magnitude is based on the second distance and a second force imparted onto the input surface.

[0005] In general, in one aspect, one or more embodiments relate to an indirect input device including sensor electrodes configured to generate sensing signals, and a processing system connected to the sensor electrodes. The processing system configured to determine a first touchdown location of an input object, determine a first subsequent location of the input object, calculate a first direction and a first distance between the first touchdown location and the first subsequent location, and move a cursor representation on a display in a second direction and at a velocity. The second direction is defined by the first direction, and the velocity is based on the first distance and a first force imparted by the input object on an input surface. The processing system is further configured to detect a touchdown event of at least two input objects, determine a second touchdown location of the at least two input objects, determine a second subsequent location of the at least two input objects, calculate a third direction and a second distance from the second touchdown location and the second subsequent location, and modulate a user interface action in a fourth direction at a magnitude. The fourth direction is based on the third direction, and the magnitude is based on the second distance and a second force imparted onto the input surface.

[0006] Other aspects of the invention will be apparent from the following description and the appended claims.

BRIEF DESCRIPTION OF DRAWINGS

[0007] The preferred exemplary embodiment of the present invention will hereinafter be described in conjunction with the appended drawings, where like designations denote like elements.

[0008] FIGS. **1** and **2** are block diagrams of an example system in accordance with one or more embodiments of the invention.

[0009] FIGS. **3** and **4** are flowcharts in accordance with one or more embodiments of the invention.

[0010] FIGS. **5** and **6** show examples in accordance with one or more embodiments of the invention.

DETAILED DESCRIPTION

[0011] The following detailed description is merely exemplary in nature, and is not intended to limit the invention or the application and uses of the invention. Furthermore, there is no intention to be bound by any expressed or implied theory presented in the preceding technical field, background, brief summary or the following detailed description.

[0012] In the following detailed description of embodiments of the invention, numerous specific details are set forth in order to provide a more thorough understanding of the invention. However, it will be apparent to one of ordinary skill in the art that the invention may be practiced without these specific details. In other instances, well-known features have not been described in detail to avoid unnecessarily complicating the description.